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January 25, 2002

CALIFORNIA ENERGY COMMISSION
Docket Unit, MS-4
1516 Ninth Street
Sacramento, CA 95814-5512

DOCKET
01-AFC-14
DATE JAN 2 5 2002
RECD. JAN 2 5 2002

Re: Docket No. 01-AFC-14

Dear Sir/Madame:

Enclosed for filing with the California Energy Commission are an original and 12 (twelve) copies of the attached **System Impact Study Report Dated November 12, 2001**. An electronic copy of REF Studies as been provided to the Docket Office and Lance Shaw.

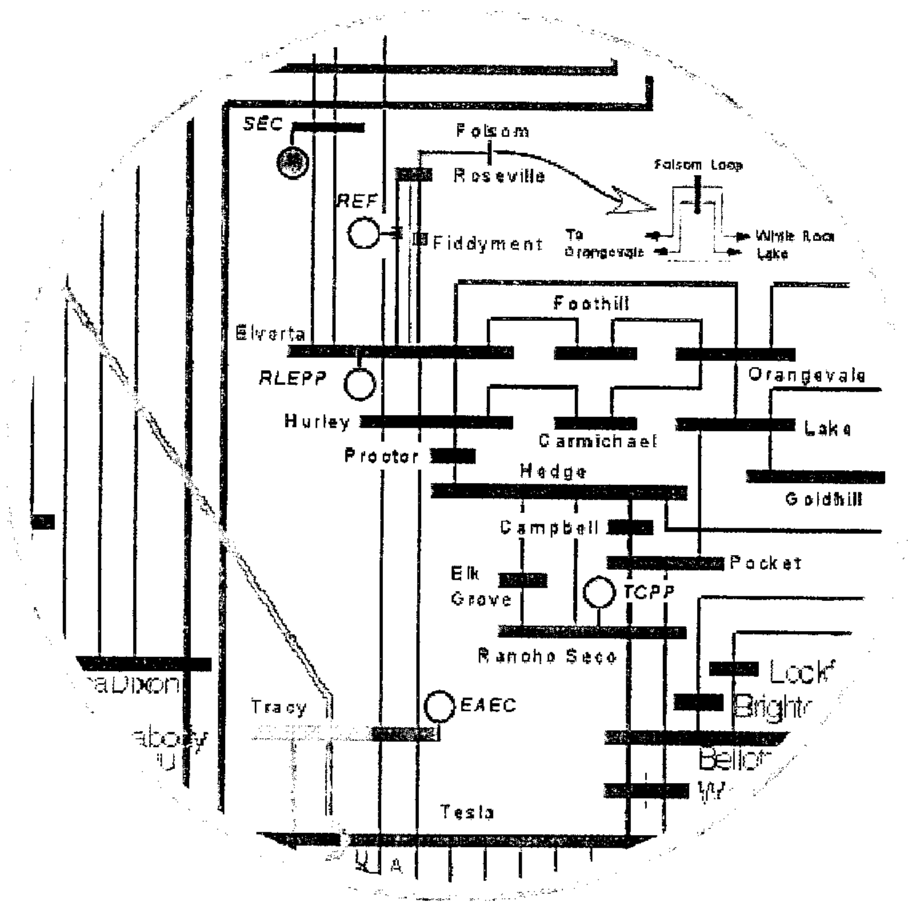
Sincerely,

Allan J. Thompson
One of Counsel
Roseville Energy Facility, L.L.C.

AJT:dmg
Enclosures
Cc: Service List

ROSEVILLE ENERGY FACILITY, L.L.C.
INTERCONNECTION

SYSTEM IMPACT STUDY REPORT



PREPARED BY

WESTERN AREA POWER ADMINISTRATION
SIERRA NEVADA REGION

NOVEMBER 12, 2001

To Website

Table of Contents

Lance Shaw, Siting Project Manager
5 Feb '02

Page No.

EXECUTIVE SUMMARY

Roseville Energy Facility L.L.C. (REF) has requested Western Area Power Administration (Western) to conduct a System Impact Study (SIS) to evaluate feasibility of interconnecting a 900 MW combined cycle generation project, called the Roseville Energy Facility, L.L.C. (REF), to Western's Roseville Substation in the northeast corner of Sacramento County. This plant is planned to be in operation in the first quarter of 2005.

This study addresses the impacts of the 900 MW generation plant on the Western's and the neighboring utilities transmission system. The study is based on the Pacific Gas & Electric (PG&E) Area 5, 2005 Heavy Summer and 2005 Spring Full Loop base cases from PG&E's transmission expansion series of base cases.

The Western Systems Coordinating Council (WSCC) and the North American Electric Reliability Council (NERC) planning criteria, as well as Western's "General Requirements for Interconnection" were used to evaluate the impact of the REF on the Western and neighboring utilities transmission system.

Figure 1, on the following page, shows the interconnection configuration that is considered for the preliminary impact study of the REF. Prior to deciding this interconnection configuration for the SIS, Western performed several screening studies to evaluate the merit of various system configurations. These configurations consisted of a combination of interconnections with PG&E and SMUD transmission at several locations on the northeast side of the Sacramento County. None of these scenarios produced the results that merited further study, however the drawings showing these interconnection configurations and screening level study results are included in this report in the latter part of Appendix III.

The interconnection configuration in Figure 1 assumes that Western's Cottonwood-Roseville 230-kV line will be reconfigured to Cottonwood-Elverta, Elverta-Roseville. The Elverta-Roseville section will be upgraded/reconstructed and looped in the new REF 230-kV Substation near the proposed plant. Looping of the two SMUD 230-kV circuits, Whiterock-Orangevale, and Lake- Orangevale into Western's Folsom Substation eliminates some of the n-0 overloads except for the Hurley-Procter and Elverta-NatomaS as seen in Table 2.

The preliminary SIS results indicate that the REF provides additional reactive support which significantly increases the load serving capability within the Sacramento region. However, the proposed generation creates severe local thermal overloads under both normal and contingency conditions. The proposed interconnection is feasible **only if** the following transmission lines reconfiguration and upgrades are implemented as noted and shown in Figure 1 and as listed below:

1. Reconfigure the existing Cottonwood – Roseville 230-kV line to Cottonwood – Elverta and Roseville – Elverta. This change may require tower modifications or a new tower at a junction about one mile north of Elverta, see Figure 1;

2. Intercept the Roseville – Elverta 230-kV section of the reconfigured Cottonwood – Roseville 230–kV line near northwest of the Fiddyment Substation and loop this circuit in the new REF plant substation;

3. Upgrade the two sections of the above circuit to the maximum possible, preferably 900 MW or 2400 Amps load carrying capability to withstand n-1 contingency for either section – post REF performance requirement. Should the new reconductored line have a capacity less than 900 MW, REF must have a Remedial Action Scheme to instantly reduce generation to the line capability under n-1 condition for the plant outlet;

4. Construct a new double circuit 230-kV line between Roseville and Folsom on the existing Western owned right of way on the south side of the existing Folsom – Roseville 230-kV single circuit line, see Figure 1.

5. Reconfigure the existing Fiddyment Roseville to Fiddyment – Folsom, using the existing Roseville – Folsom line. The existing breaker bay at Roseville would be used for the new circuit between Roseville and Folsom, hence eliminating the need for additional breaker at Roseville Substation, which has limited room for additional breakers as shown in Figure 1;

6. Loop SMUD's Lake – Orangevale and Whiterock – Orangevale 230–kV lines in Western's Folsom substation, see Figure 1;

7. The following transmission circuits must be upgraded in order to sustain n-1 contingencies:

    a. Lake – Folsom 230-kV
    b. Folsom – Orangevale 230-kV, both circuits 1 and 2
    c. Elverta – Natomas 230-kV
    d. Hurley – Proctor 230-kV
    e. Natomas – Hurley 230-kV
    f. Western's Elverta – Hurley #1 & #2 230 – kV lines

8. Replace overstressed breakers at SMUD's Elverta Substation with breakers with higher interrupting rating. Three of SMUD's Elverta Substation overstressed breakers have to be replaced with higher fault duty breakers. The other two overstressed breakers are being replaced as a result of another project. Should that other project not go forward these two breakers also have to be replaced.

9. The System Impact Study has been presented to the impacted neighboring utilities and is under review by them. Upon the receipt of the review comments Western will

consider the inputs, re-evaluate the interconnection configuration and perform a thorough study from an engineering and construction feasibility point of view. The operational and maintenance reliability and flexibility, and bus section outages and staging for construction will be done in the next phase when performing the Detailed Facility Interconnection Study (DFIS).

10. City of Roseville's overstressed breakers at the Fiddyment and Berry 60–kV substations must be mitigated.

Roseville Energy Facility Interconnection Configuration

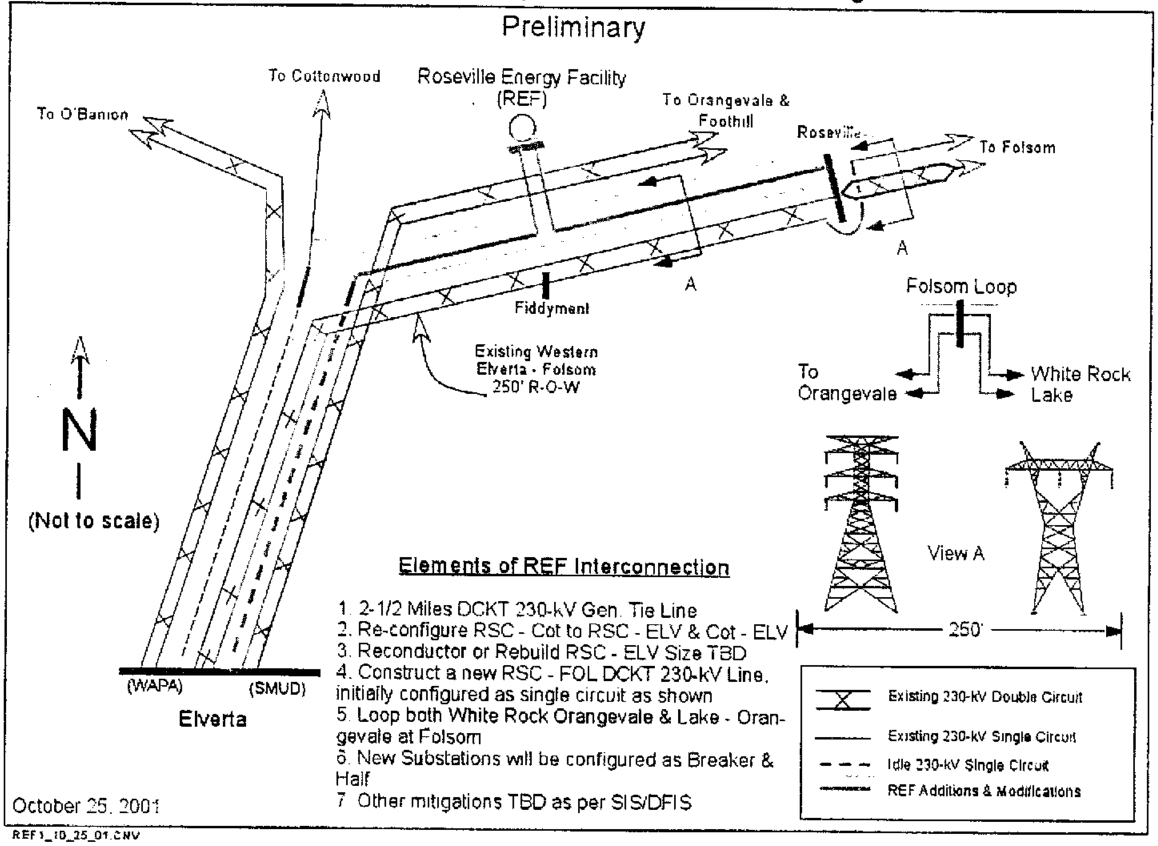


Figure 1

Dynamic stability studies performed indicated that REF has no significant impact on the stable operation of the Western and neighboring utilities' transmission system following the selected disturbances listed in Table 11.

The DIFS, which is the next phase of the SIS work, will determine the conceptual design, facility development and the operational requirements for interconnecting REF to Western's transmission system. The DIFS would take into consideration the results of the SIS and the new station layout for bus section outages, construction staging, etc. The DFIS will be the basis for the interconnection agreement and will define the scope of required facilities.

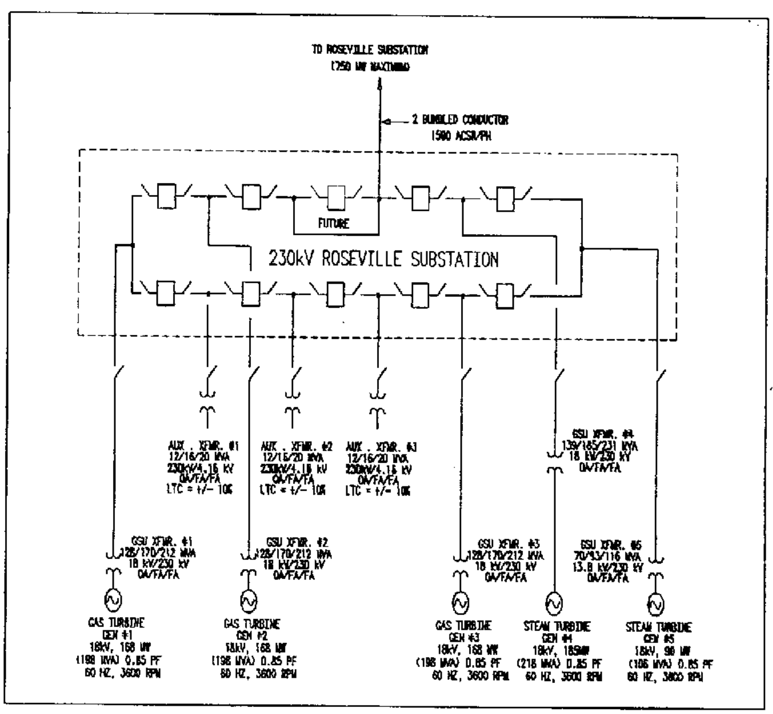
The results of short circuit studies conducted (Table 12) indicate that this plant addition would cause an increase of; 68% in the maximum available fault at Roseville 230-kV, 24% at the Elverta 230-kV, 182 % at Folsom, 24 % at SMUD's Elverta, 35% at Lake, and 19% at Fiddyment 230-kV substations. The existing breakers at SMUD's Elverta substation will be overstressed beyond their interrupting rating with the new available fault level caused by the addition of the REF plant.

The Figure 1, above depicts the base case configuration for REF.

PROJECT DESCRIPTION

In February 2001, Roseville Energy Facility, L.L.C. submitted a request for interconnection to Western. REF requested Western to perform a SIS to evaluate the feasibility of this interconnection. REF's proposal is for a direct interconnection of a 900 MW combined cycle plant comprised of four units in Sacramento County (near Western's Cottonwood-Roseville 230-kV transmission line) with Western's Roseville 230-kV substation. The plant will be called Roseville Energy Facility and is planned for commercial operation in the first quarter of 2005. Western's preliminary interconnection configuration is as shown in Figure 1.

Initially REF proposed the following configuration in their interconnection request to Western. Subsequently, western performed several studies based on various interconnection configuration which resulted in the proposed configuration as shown in Figure 1. These screening studies were performed to reduce the number of n-0 overload violations. The table of results is at the latter part of appendix III.



STUDY OBJECTIVES

The objective of this study is to identify the necessary transmission facility additions required to interconnect the REF with Western's 230-kV transmission system at Roseville/Elverta Substation consistent with the stated reliability and performance requirements. The study focuses on the anticipated summer peak load condition for the 2005 summer season. The base case load assumption, most critical season, with one in ten load forecast for the Sacramento area, and PG&E's Area 5 (Sierra). The load forecast for the surrounding are temperature adjusted. Potential operating restrictions as well as transmission reinforcements needed to integrate the plant into the electrical system will be identified. The study includes steady state power flow analysis, dynamic stability studies for several disturbances and short circuit studies for identifying the impact on the fault duty of the existing equipment. The SIS does not address the conceptual design, facility development and the operational requirements for interconnecting REF to Western's transmission system that will be addressed in the DFIS.

STEADY STATE POWER FLOW STUDIES RESULTS

2005 Heavy Summer Base Case

The power flow studies were performed using the PG&E 2005 Heavy Summer and the 2005 Spring full loop base cases. A summary of the assumptions for the generation, load and paths flows (COI, PDCI, Path 26 etc.) for these base cases are included in the study plan under Appendix I.

Table 1 – 2005 HS Base Case Summary

Summaries of Base Cases			
	Max. (MW)	**2005HS**	**2005 Spr**
COI Flow (Path 66)	4800	3632	1742
PDCI	3100	3100	2503
MidWay-Vincent Flow (Path 26) (MW)	3000	2824	2997
New Generation Projects (MW, not including REF) *		5959	4066
Helms	1212	600	400
PG&E area Load (MW)		~26,842.6	~18.579.5
Sacramento area Load (also included in PG&E area) (MW)		3,552	1,815.60
Northen California Hydro (MW)	4013	3444.6(86.4%)	2694.4(67.6%)
QF		Historical diversity level by unit.	
Morro Bay # 4 is the Swing bus in both cases.			

*: Despte the recommendation in the Study Plan new generation projects from level 1 to 5 are included.

The contingencies simulated in this study include n-1 and n-2 outages in the SMUD and Western systems and post transient studies for single and double line 500-kV. The results indicated that the interconnection of REF to Western's Roseville/Elverta 230-kV Substation would cause overloads for facilities listed in the base case overload summary, Table 2. These overloads are based on the facility's normal ratings.

Table 2 – Base Case (**n-0**) Flow Comparison for 2005HS case, With and W/O REF (based on Figure 1)

OVERLOADED ELEMENTS					BASE MVA	Loading in % of Normal Rating W/ REF @900 MW	Loading in % of Normal Rating W/O REF	DELTA (%)	Loading in % of Normal Rating W/REF & W/O FPLE	Loading in % of Normal Rating W/ REF @750 MW & W/FPLE
From		To		Ckt #						
ELVERTAS	230	NATOMAS	230	1	388.34	**128.77**	**102.55**	26.22	106.18	122.22
HURLEY S	230	PROCTER	230	1	374.97	**124.42**	**86.33**	38.09	86.81	115.95
FOLSOM	230	LAKE	230	1	298.08 *	98.58	11.42	87.16	65.13	87.67
PROCTER	230	HEDGE	230	1	530.14	87.89	68.03	19.86	68.54	83.6

*: 11.42% is the flow on Lake-Orangevale before ~~this~~ reconfiguration.

The addition of the proposed 500 MW plant at Rancho Seco the base case overloads would be reduced as shown in the following table.

Table 3 – Base Case (**n-0**) Flow Comparison, 2005HS case, W/ REF & W & W/O RanchoSeco.

OVERLOADED ELEMENTS					LOADING IN % OF NORMAL RATING W/ REF & W/O RSECO	LODING IN % OF NORMAL RATING W/ REF & RSECO	DELTA (%) *
From		To		CKT #			
ELVERTAS	230	NATOMAS	230	1	128.77	125.57	**-3.2**
HURLEY S	230	PROCTER	230	1	124.42	83.89	**-40.53**
FOLSOM	230	LAKE	230	1	98.58	92.02	**-6.56**
PROCTER	230	HEDGE	230	1	87.89	66.86	**-21.03**
ELVERTAS	115	NORTHCTY	115	1	85.33	76.75	**-8.58**
TRCY PMP	230	TESLA D	230	2	82.49	85.84	**3.35**
HURLEY	115	HURLEY S	230	1	76.25	70.25	**-6**
WHITEROK	230	HEDGE	230	1	74.69	68.7	**-5.99**
NATOMAS	230	HURLEY S	230	1	73.59	70.72	**-2.87**

*: Negative sign indicates a reduction in loading.

The overloads for contingency cases are compared against the emergency rating (SMUD and PG&E). Western does not have an emergency rating for it's transmission lines to be used in planning studies) of the facilities. These tables show the facilities with a change in loading of at least 2%. Western believes that a change in loading of less than 2% is within the margin of error in the modeling and calculations algorithm.

Table 4 below indicates a portion of the n-1 contingencies results for facilities that before REF had a loading of below 100%. To mitigate the n-1 overloads, all the facilities that are overloaded shall be upgraded (reconductored and/or reconstructed as applicable). These facilities are: Western's Elverta-Hurley #1 & #2, SMUD's ElvertaS-NatomaS, Folsom-Lake (portion of the reconfigured Lake-Orangevale), and Hurley Procter 230-kV lines. In Table 4 (complete table is under appendix III), the loading before and after REF are compared and the difference is shown in percent of emergency rating of the facility. It should be noted that Rio Linda bus, the interconnection point for the FPLE plant, about 2000 feet south of the existing Elverta 230-kV is no longer considered and the FPLE or Rio Linda Power Plant is now being evaluated for a direct interconnection at Elverta 230-kV. The Rio Linda 230-kV bus would have been an extension of the Elverta 230-kV bus.

Table 4 – Summary of n-1 outages, in SMUD & Western, 2005 HS case W/ & W/O REF

Overloaded Element					OUTAGE	LOADING IN % OF EMERGENCY RATING W/ REF	LOADING IN % OF EMERGENCY RATING W/O REF	DELTA (%) **
From		To		Ckt #				
RIOLINDA *	230	HURLEY S	230	2	ELVERTAS - ELVERTAW 230 1	179.21	207.32	-28.11
RIOLINDA *	230	HURLEY S	230	1	ELVERTAS - ELVERTAW 230 1	173.19	200.35	-27.16
HURLEY S	230	PROCTER	230	1	LAKE - FOLSOM 230 1	142.36	n/a	
HURLEY S	230	PROCTER	230	1	WHITEROK - HEDGE 230 1	140.91	99.46	41.45
FOLSOM	230	LAKE	230	1	PROCTER - HEDGE 230 1	138.08	44.73	93.35
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 1 or 2	135.63	110.48	25.15
HURLEY S	230	PROCTER	230	1	POCKET - LAKE 230 1	133.11	81.42	51.69
RIOLINDA	230	HURLEY S	230	2	ELVERTAS - NATOMAS 230 1	129.53	105.89	23.64
RIOLINDA	230	HURLEY S	230	2	RIOLINDA - HURLEY S 230 1	127.58	102.16	25.42
ELVERTAS	230	NATOMAS	230	1	CARMICAL - ORANGEVL 230 1	127.1	88.95	38.15
HURLEY S	230	PROCTER	230	1	HURLEY 230/115 kV XFMR 1	126.82	92.68	34.14
FOLSOM	230	LAKE	230	1	CAMINO S - LAKE 230 1	126.19	47.76	78.43
RIOLINDA	230	HURLEY S	230	1	ELVERTAS - NATOMAS 230 1	125.18	102.33	22.85
RIOLINDA	230	HURLEY S	230	1	RIOLINDA - HURLEY S 230 2	124.8	100.08	24.72
ELVERTAS	230	NATOMAS	230	1	ROSEVILL - FOLSOM 230 2	124.21	n/a	
ELVERTAS	230	NATOMAS	230	1	ROSEVILL - REF 230 3	123.77	n/a	
HURLEY	115	HURLEY S	230	1	PROCTER - HEDGE 230 1	122.32	109.66	12.66
FOLSOM	230	LAKE	230	1	PROCTER - HURLEY S 230 1	122.09	31.5	90.59
HURLEY S	230	PROCTER	230	1	HURLEY 230/69 kV XFMR 1 or 2	121.16	88.37	32.79
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - NORTHCTY 115 1	120.56	97.38	23.18
HURLEY S	230	PROCTER	230	1	ELVERTAS - NORTHCTY 115 1	120.09	85.41	34.68
ELVERTAS	230	NATOMAS	230	1	LAKE - FOLSOM 230 1	119.73	n/a	
ELVERTAS	230	NATOMAS	230	1	WHITEROK - HEDGE 230 1	118.54	91.39	27.15
ELVERTAS	230	NATOMAS	230	1	OLINDA 500/230 kV XFMR	118.26	95.5	22.76
HURLEY S	230	PROCTER	230	1	NATOMAS 230/69 kV XFMR 1	117.7	85.34	32.36
HURLEY S	230	PROCTER	230	1	CARMICAL 230/69 kV XFMR 1	117.09	83.17	33.92
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - FOOTHILL 230 1	117	99.41	17.59
ELVERTAS	230	NATOMAS	230	1	POCKET - LAKE 230 1	116.88	89.28	27.6
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - ORANGEVL 230 1	116.41	99.65	16.76
ELVERTAS	230	NATOMAS	230	1	FIDDYMNT - ELVERTAW 230 1	116.33	88.64	27.69
ELVERTAS	230	NATOMAS	230	1	ELVERTAS 230/115 kV XFMR 1	116.25	94.04	22.21
HURLEY S	230	PROCTER	230	1	ORAGEVL 230/69 kV XFMR 2	116.21	82.18	34.03
HURLEY S	230	PROCTER	230	1	ROSEVILL - FOLSOM 230 2	116.17	n/a	
HURLEY S	230	PROCTER	230	1	ROSEVILL - REF 230 3	116.07	n/a	
HURLEY S	230	PROCTER	230	1	ORAGEVL 230/69 kV XFMR 1	115.7	81.54	34.16
ELVERTAS	230	NATOMAS	230	1	FOOTHILL 230/69 kVXFMR 1	115.01	92.69	22.32
HURLEY S	230	PROCTER	230	1	OLINDA 500/230 kV XFMR	114.93	81.58	33.35

*: RioLinda bus is actually the same as Elverta bus on the Western's side of the Elverta substation.

**: Negative sign indicates reduction in loading.

The complete table of overloaded facilities for n-1 contingencies is under Appendix III.

There was no voltage criteria violation for any of the n-1 contingencies.

Table 5 – Comparison for n-1 outages, 2005 HS case, W/REF, W/ & W/O RSECO

Overloaded Element					OUTAGE	LOADING IN % OF EMERGENCY RATING W/ REF	LOADING IN % OF EMERGENCY RATING W/ REF & RSECO	DELTA (%)
From		To		CKT #				
RIOLINDA	230	HURLEY S	230	2	ELVERTAS - ELVERTAW 230 #1	179.21	173.64	-5.57
RIOLINDA	230	HURLEY S	230	1	ELVERTAS - ELVERTAW 230 #1	173.19	167.81	-5.38
HURLEY S	230	PROCTER	230	1	LAKE - FOLSOM 230 #1	142.36	104.58	-37.78
HURLEY S	230	PROCTER	230	1	WHITEROK - HEDGE 230 #1	140.91	102.7	-38.21
FOLSOM	230	LAKE	230	1	PROCTER - HEDGE 230 #1	138.08	119.55	-18.53
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 #2	135.63	132.18	-3.45
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 #1	134.5	131.08	-3.42
HURLEY S	230	PROCTER	230	1	POCKET - LAKE 230 #1	133.11	90.73	-42.38
RIOLINDA	230	HURLEY S	230	2	ELVERTAS - NATOMAS 230 #1	129.53	126.05	-3.48
RIOLINDA	230	HURLEY S	230	2	RIOLINDA - HURLEY S 230 #1	127.58	124.1	-3.48
ELVERTAS	230	NATOMAS	230	1	CARMICAL - ORANGEVL 230 #1	127.1	124.38	-2.72
HURLEY S	230	PROCTER	230	1	HURLEY S 230/115 kV XFMR #1	126.82	89.74	-37.08
FOLSOM	230	LAKE	230	1	CAMINO S - LAKE 230 #1	126.19	121.51	-4.68
RIOLINDA	230	HURLEY S	230	1	ELVERTAS - NATOMAS 230 #1	125.18	121.82	-3.36
RIOLINDA	230	HURLEY S	230	1	RIOLINDA - HURLEY S 230 #2	124.8	121.4	-3.4
ELVERTAS	230	NATOMAS	230	1	ROSEVILL - FOLSOM 230 #2	124.21	120.85	-3.36
ELVERTAS	230	NATOMAS	230	1	ROSEVILL - REF 230 #3	123.77	120.77	-3
HURLEY	115	HURLEY S	230	1	PROCTER - HEDGE 230 #1	122.32	105.45	-16.87
FOLSOM	230	LAKE	230	1	PROCTER - HURLEY S 230 #1	122.09	103.72	-18.37
HURLEY S	230	PROCTER	230	1	HURLEY S 230/69 kV XFMR #1	121.16	85.85	-35.31
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - NORTHCTY 115 #1	120.56	116.83	-3.73
HURLEY S	230	PROCTER	230	1	ELVERTAS - NORTHCTY 115 #1	120.09	83.6	-36.49
HURLEY S	230	PROCTER	230	1	HURLEY S 230/69 kV XFMR #2	120.02	84.16	-35.86
ELVERTAS	230	NATOMAS	230	1	LAKE - FOLSOM 230 #1	119.73	116.38	-3.35
ELVERTAS	230	NATOMAS	230	1	WHITEROK - HEDGE 230 #1	118.54	115.14	-3.4
ELVERTAS	230	NATOMAS	230	1	OLINDA 500/230 kV XFMR #1	118.26	116.04	-2.22
HURLEY S	230	PROCTER	230	1	NATOMAS 230/69 kV XFMR #1	117.7	82.32	-35.38
HURLEY S	230	PROCTER	230	1	CARMICAL 230/69 kV XFMR #1	117.09	81.61	-35.48
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - FOOTHILL 230 #1	117	114.09	-2.91

*: Negative sign indicates a reduction in loading.

Detailed tables of power flow studies results for all n-1 and n-2 contingencies are under Appendix II.

As seen from the following table, the n-2 contingencies also result in numerous facilities overloads.

There was no voltage criteria violation for any of the n-2 contingencies.

Table 6 – Comparison for n-2 outages, 2005 HS case, W/ & W/O REF

Overloaded Element					OUTAGE	LOADING IN % OF EMERGENCY RATING W/ REF	LOADING IN % OF EMERGENCY RATING W/O REF	DELTA (%)
From		To		CKT #				
HURLEY S	230	PROCTER	230	1	WHITEROK - HEDGE 230 #1 & POCKET - LAKE 230 #1	183.19	117.08	66.11
WHITEROK	230	FOLSOM	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	163.18	n/a	
FOLSOM	230	LAKE	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	148.86	65.85	83.01
HURLEY S	230	PROCTER	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	146.61	111.67	34.94
FOLSOM	230	LAKE	230	1	PROCTER - HEDGE 230 #1 & HEGE - EAST CTY 115 #1	139.44	44.72	94.72
NATOMAS	230	HURLEY S	230	1	RIOLINDA - HURLEY S 230 #1 & #2	137.25	111.57	25.68
HURLEY S	230	PROCTER	230	1	FOLSOM -WHITEROK 230 #1 & LAKE - FOLSOM 230 #1	130.05	n/a	
HURLEY S	230	PROCTER	230	1	LAKE - POCKET 230 #1 & HEDGE - CAMPBELL 230 #1	128.17	79.98	48.19
ELVERTAS	230	NATOMAS	230	1	WHITEROK - HEDGE 230 #1 & POCKET - LAKE 230 #1	127.87	93.28	34.59
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - FOOTHILL 230 #1 & ELVERTAS - ORANGEVL 230 #1	124.48	118.51	5.97
ELVERTAS	230	NATOMAS	230	1	FOLSOM - ORANGEVL 230 #1 & #2	124.23		124.23
HURLEY S	230	PROCTER	230	1	LAKE - POCKET 230 #1 & CAMPBELL - POCKET 230 #1	124.17	76.55	47.62
FOLSOM	230	LAKE	230	1	HURLEY - EAST CTY 115 #1 & HURLEY S - PROCTER 230 #1	123.08	32.5	90.58
ELVERTAS	230	NATOMAS	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	120.15	93.06	27.09
HURLEY	115	HURLEY S	230	1	PROCTER - HEDGE 230 #1 & HEGE - EAST CTY 115 #1	119.66	110.13	9.53
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - ORANGEVL 230 #1 & FOOTHILL - ORANGEVL 230 #1	119	107.97	11.03
ELVERTAS	230	NATOMAS	230	1	FIDDYMNT - ELVERTAW 230 #1 & ROSEVILL - ELVERTAW 230 #1	118.37		118.37
ELVERTAS	230	NATOMAS	230	1	ROSEVILL - ELVERTAW 230 #1 & FIDDYMNT - ELVERTAW 230 #1	118.37		118.37
ELVERTAS	230	NATOMAS	230	1	ELVERTAS - FOOTHILL 230 #1 & FOOTHILL - ORANGEVL 230 #1	118.23	99.29	18.94
ELVERTAS	230	NATOMAS	230	1	FOLSOM -WHITEROK 230 #1 & LAKE - FOLSOM 230 #1	117	n/a	
ELVERTAS	230	NATOMAS	230	1	LAKE - POCKET 230 #1 & HEDGE - CAMPBELL 230 #1	116.44	89.21	27.23
ELVERTAS	230	NATOMAS	230	1	LAKE - POCKET 230 #1 & CAMPBELL - POCKET 230 #1	115.99	88.79	27.2
TRCY PMP	230	TESLA D	230	1	EAEC - WESTLEY 230 #1 & 2	115.62	99.5	16.12
TRCY PMP	230	TESLA D	230	2	EAEC - WESTLEY 230 #1 & 2	115.62	99.5	16.12
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - ELVERTAW 230 #1 & #2	115.18	73.7	41.48
ELVERTAS	230	ELVERTAW	230	1	RIOLINDA - HURLEY S 230 #1 & #2	114.45	112.3	2.15
HURLEY S	230	PROCTER	230	1	EAEC - WESTLEY 230 #1 & 2	114.27	80.99	33.28

2005 Spring Base Case

The studies were also conducted using a 2005 spring base case. Table 1 shows the summary of the 2005 spring base case for the generation, load and paths flows.

Table 7 – Base Case (**n-0**) Flow Comparison, W/ and W/O REF for 2005 spring

Base Case							
OVERLOADED ELEMENTS					LOADING IN % OF NORMAL RATING W/ REF	LOADING IN % OF NORMAL RATING W/O REF	DELTA (%)
From		To		CKT #			
PROCTER	230	HEDGE	230	1	123.49	86.95	36.54
ELVERTAS	230	NATOMAS	230	1	113.89	89.25	24.64
TRCY PMP	230	TESLA D	230	1	111.73	87.16	24.57
TRCY PMP	230	TESLA D	230	2	111.73	87.16	24.57
HURLEY S	230	PROCTER	230	1	108.5	71.25	37.25
FOLSOM	230	LAKE	230	1	105.29	19.72	85.57

The n-1 studies results for the 2005 spring case also shows that several facilities would overload. A portion of the list of overloaded elements is in the following Table 8.

Table 8 – Flow Comparison, for n-1 W/ and W/O REF for 2005 Spring

OVERLOADED ELEMENTS					OUTAGE	LOADING IN % OF EMERGENCY RATING W/ REF	LOADING IN % OF EMERGENCY RATING W/O REF	DELTA (%)
From		To		CKT				
RIOLINDA	230	HURLEY S	230	1&2	ELVERTAS - ELVERTAW 230 #1	159.83	176.37	-16.54
TRCY PMP	230	TESLA D	230	1&2	TRCY PMP - TESLA D 230 #1 OR #2	148.02	115.47	32.55
PROCTER	230	HEDGE	230	1	LAKE - FOLSOM 230 #1	141.53	N/A	
PROCTER	230	HEDGE	230	1	POCKET - LAKE 230 #1	133.34	84.4	48.94
PROCTER	230	HEDGE	230	1	WHITEROK - HEDGE 230 #1	129.93	90.85	39.08
HURLEY S	230	PROCTER	230	1	LAKE - FOLSOM 230 #1	128.69	N/A	
FOLSOM	230	LAKE	230	1	PROCTER - HEDGE 230 #1	127.8	39.09	88.71
RIOLINDA	230	HURLEY S	230	1&2	RIOLINDA - HURLEY S 230 #1 OR #2	127.72	104.18	23.54
RIOLINDA	230	HURLEY S	230	1&2	ELVERTAS - NATOMAS 230 #1	125.72	103.24	22.48
FOLSOM	230	LAKE	230	1	PROCTER - HURLEY S 230 #1	123.54	35.34	88.2
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 #2	122.86	99.4	23.46
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 #1	121.74	98.35	23.39
PROCTER	230	HEDGE	230	1	TRCY PMP - HURLEY S 230 #2	121.6	79.17	42.43
PROCTER	230	HEDGE	230	1	TRCY PMP - HURLEY S 230 #1	121.23	79.06	42.17
HURLEY S	230	PROCTER	230	1	POCKET - LAKE 230 #1	120.46	70.9	49.56
RIOLINDA	230	HURLEY S	230	1&2	NATOMAS - HURLEY S 230 #1	117.82	94.17	23.65
PROCTER	230	HEDGE	230	1	HURLEY S 230/115 kV XFMR #1	117.11	84.45	32.66
HURLEY S	230	PROCTER	230	1	WHITEROK - HEDGE 230 #1	117.06	77.33	39.73
PROCTER	230	HEDGE	230	1	ELVERTAS - NORTHCTY 115 #1	116.61	83.41	33.2
ELVERTAS	230	NATOMAS	230	1	CARMICAL - ORANGEVL 230 #1	115.96	78.57	37.39
PROCTER	230	HEDGE	230	1	ROSEVILL - FOLSOM 230 #2	115.83	N/A	
PROCTER	230	HEDGE	230	1	OLINDA 500/230 kV XFMR #1	115.8	84.06	31.74
FOLSOM	230	LAKE	230	1	CAMINO S - LAKE 230 #1	115.45	40.56	74.89
PROCTER	230	HEDGE	230	1	HURLEY S 230/69 kV XFMR #1	113.55	82.19	31.36

Table 9 – Flow Comparison, for n-2 W/ and W/O REF for 2005 Spring

OVERLOADED ELEMENTS					OUTAGE	LOADING IN % OF EMERGENCY RATING W/ REF	LOADING IN % OF EMERGENCY RATING W/O REF	DELTA (%)
From		To		CKT #				
ELVERTAS	230	NATOMAS	230	1	RIOLINDA - HURLEY S 230 #1 & #2	172.62	149.09	23.53
PROCTER	230	HEDGE	230	1	WHITEROK - HEDGE 230 #1 & POCKET - LAKE 230 #1	170.9	108.44	62.46
HURLEY S	230	PROCTER	230	1	WHITEROK - HEDGE 230 #1 & POCKET - LAKE 230 #1	158.1	94.97	63.13
PROCTER	230	HEDGE	230	1	FOLSOM -WHITEROK 230 #1 & LAKE - FOLSOM 230 #1	150.81	N/A	
NATOMAS	230	HURLEY S	230	1	RIOLINDA - HURLEY S 230 #1 & #2	147.42	124.11	23.31
PROCTER	230	HEDGE	230	1	TRCY PMP - HURLEY S 230 #1 & #2	145.61	85.66	59.95
HURLEY S	230	PROCTER	230	1	FOLSOM -WHITEROK 230 #1 & LAKE - FOLSOM 230 #1	137.97	N/A	
HURLEY S	230	PROCTER	230	1	TRCY PMP - HURLEY S 230 #1 & #2	133.15	72.19	60.96
PROCTER	230	HEDGE	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	133.15	97.56	35.59
FOLSOM	230	LAKE	230	1	LAKE - CAMINO 230 #1 & WHITEROK - HEDGE 230 #1	132.38	52.85	79.53
FOLSOM	230	LAKE	230	1	PROCTER - HEDGE 230 #1 & HEGE - EAST CTY 115 #1	131	40.58	90.42
PROCTER	230	HEDGE	230	1	LAKE - POCKET 230 #1 & HEDGE - CAMPBELL 230 #1	126.96	81.28	45.68
PROCTER	230	HEDGE	230	1	LAKE - POCKET 230 #1 & CAMPBELL - POCKET 230 #1	126.2	80.69	45.51
TRCY PMP	230	TESLA D	230	1&2	EAEC - WESTLEY 230 #1 & 2	126.07	101.19	24.88

Western also conducted sensitivity studies with REF at 600 MW output to evaluate the impacted facilities at his lower generation level. The results are under Appendix III.

Table 10 – Base Case (**n-0**) Flow Comparison for 2005HS case, W/ REF at 600MW and W/O REF.

OVERLOADED ELEMENTS					LOADING IN % OF NORMAL RATING W/ 600MW REF	LOADING IN % OF NORMAL RATING W/O REF	DELTA (%)
From		To		CKT #			
ELVERTAS	230	NATOMAS	230	1	115.68	102.55	13.13
HURLEY S	230	PROCTER	230	1	107.53	86.33	21.2

As seen from the above table the facilities are still overloaded.

DYNAMIC STABILITY STUDIES

Dynamic Stability studies were performed for the disturbances listed in the table below.

Table 11 – Disturbances for Dynamic Stability Studies

List of Dynamic Stability Disturbances	
1	3-phase 6-cycle fault at the Elverta 230 kV, west section, bus, followed by tripping of both ELVERTAW-RIOLINDA 230 kV lines.
2	3-phase fault with 14-cycle clearing at the Elverta 230 kV, east section, bus.
3	3-phase fault with 14-cycle clearing at the Elverta 230 kV, west section, bus.
4	3-phase fault with 6-cycle clearing at the REF 230 kV bus.
5	3-phase 6-cycle fault at the REF 230 kV bus, followed by tripping of REF 230-Elverta 230 kV line.
6	3-phase fault with 6-cycle clearing at the REF 230 kV bus followed by tripping of all REF units.
7	3-phase 6-cycle fault at the REF 230 kV bus, followed by tripping of REF 230-Roseville 230 kV line.
8	3-phase 6-cycle fault at the Roseville 230 kV bus, followed by tripping of Roseville-Folsom 230 kV line.
9	3-phase fault at the Roseville 230 kV bus with 6 cycle clearing.
10	3-phase fault at the Roseville 230 kV bus with 6 cycle clearing followed by tripping of Roseville-Elverta 230 kv line.
11	3-phase fault at the Roseville 230 kV bus with 6 cycle clearing followed by tripping of REF 230-Roseville 230 kV line.

Dynamic stability studies were conducted to determine whether the REF would create instability following selected outages. Table 6 outlines the outage scenarios assumed for this analysis. The results indicated that the REF would have no adverse impact on the stable operation of the transmission system following the selected disturbances.

STUDY CRITERIA

According to the *WSCC Disturbance-Performance Table of Allowable Effects on Other Systems*[1], after a Category "B" (n-1), disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 25 percent at load buses or 30 percent at non-load buses at any time.

[1] Cited from Draft Western System Coordinating Council (WSCC) Planning Standards published in December 2, 1999.

- The duration of the transient voltage dip greater than 20 percent should not exceed 20 cycles at load buses.
- The minimum transient frequency should not fall below 59.6 Hz for 6 cycles or more at load buses.

After a Category "C" (n-2), disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 30 percent at any bus at any time.
- The duration of a transient voltage dip greater than 20 percent should not exceed 40 cycles at load buses.
- The minimum transient frequency should not fall below 59.0 Hz for 6 cycles or more at load buses.

FAULT STUDY RESULTS

The fault studies were performed with a 2005 case. This case includes models for all of the future system additions such as approved PG&E transmission expansion projects and new licensed generation projects for up to year 2005.

The following table shows the maximum available fault for several buses with and without the REF project.

Table 12 – Summary of Fault Duty for buses at Roseville, Elverta & several SMUD substations.

SUMMARY OF FAULT CURRENT STUDIES					
Substation Name & kV	**Max. Fault Current in Amps. (Existing System)**	**Max. Fault Current in Amps. (2005 System w/o REF)**	**Max. Fault Current in Amps. (2005 System w/ REF & 2-SMUD lines looped @ FOL)**	**% Increase**	**PCB's Interrupting Rating in Amps.**
Roseville 230 kV	13,305	14,816	24,912	68.14%	31,500
Roseville 69 kV	28,286	30,263	35,379	16.91%	40,000
Fiddyment 230kV	13,549	15,258	18,126	18.80%	
Folsom 230kV	9,079	9,703	27,349	181.86%	40,000
Elverta 230 kV (Western)	20,644	26,108	32379	24.02%	40,000
Elverta 230kV (SMUD)	20,601	25994	**32130**	23.61%	2 @ 18,000 & 3 @ 26,000
Hurley 230kV (SMUD)	22,226	25,687	29,544	15.02%	5 @ 40,000, 1 @ 39,000, 3 @ 37,500, 1 @ 33,000
Hedge 230kV	22073	23347	24685	5.73%	26,600
Orangevale	18,136	20,185	25,197	24.83%	1 @ 26,000, 3 @ 33,000, & 3 @ 40,000
Foothills	11,397	12,468	13,615	9.20%	40, 000
Lake	14,532	15,406	20,801	35.02%	
Carmichel	17,746	19,757	23,388	18.38%	40,000
Camino	11,750	12,122	13,184	8.76%	
Tracy 230	42,708	58,050	58,309	0.45%	63,000

*: Single Line to Ground fault

The breakers that are stressed over their interrupting rating, such as three breakers on the SMUD side of the Elverta 230 kV and 60 - kV breakers at Roseville substation, should be replaced.

CONCLUSION

The system impact study results indicate that the interconnection of REF with Western's Roseville and Elverta 230-kV substations is feasible only based on the following system reconfiguration and conditions. These reconfigurations/upgrades are based on the assumptions that prior upgrades/reconductoring required as a condition of interconnection for other projects such as Rio Linda PP are already in place.

1. Intercept the Roseville – Elverta 230-kV section of the reconfigured Cottonwood – Roseville 230 – kV line near northwest of the Fiddyment Substation and loop this circuit in the new REF plant substation;

2. Upgrade the two sections of the above circuit to the maximum possible, preferably 900 MW or 2400 Amps load carrying capability to withstand n-1 contingency for either section – post REF performance requirement. Should the new reconductored line have a capacity less than 900 MW, REF must have a Remedial Action Scheme to instantly reduce generation to the line capability under n-1 condition for the plant outlet;

3. Reconfigure the existing Cottonwood – Roseville to Cottonwood – Elverta and Roseville – Elverta. This change may require tower modifications at a junction about one mile north of Elverta, Figure 1

4. Construct a new double circuit 230-kV between Roseville and Folsom on the existing Western owned right of way on the south side of the existing Folsom – Roseville 230-kV single circuit line, see Figure 1.

5. Reconfigure the existing Fiddyment Roseville to Fiddyment – Folsom, using the existing Roseville – Folsom line. The existing breaker bay at Roseville would be used for the new circuit between Roseville and Folsom, hence eliminating the need for additional breaker at Roseville Substation, which has limited room for additional breakers as shown in Figure 1;

6. Loop SMUD's Lake – Orangevale and Whiterock – Orangevale 230 – kV lines in Western's Folsom substation, see Figure 1;

7. The following transmission circuits must be upgraded in order to sustain n-1 contingencies:

    g. Lake – Folsom 230-kV
    h. Folsom – Orangevale 230-kV, both circuits 1 and 2
    i. Elverta – Natomas 230-kV
    j. Hurley – Proctor 230-kV
    k. Natomas – Hurley 230-kV
    l. Western's Elverta – Hurley #1 & #2 230 – kV lines

8. Replace overstressed breakers at SMUD's Elverta Substation with breakers with higher interrupting rating. Three of SMUD's Elverta Substation overstressed breakers have to be replaced with higher fault duty breakers. The other two overstressed breakers are being replaced as a result of another project. Should that other project not go forward these two breakers also have to be replaced.

9. The System Impact Study has been presented to the impacted neighboring utilities and is under review by them. Upon the receipt of the review comments Western will consider the inputs, re-evaluate the interconnection configuration and perform a thorough study from an engineering and construction feasibility point of view as well as operational and maintenance reliability and flexibility, for various bus section outages when performing the DFIS.

10. City of Roseville's overstressed breakers at the Fiddyment and Berry 60 – kV substations must be mitigated.

APPENDIX I

STUDY PLAN

Roseville Energy Facility
System Impact Study Plan

I. Background and Purpose

The purpose of this System Impact Study (SIS) is to evaluate the technical feasibility of, and to identify the preliminary direct interconnection requirements, for the proposed REF's 750 MW Roseville Energy Facility planned to be on-line by May 2004. The proposed site is approximately 1.5 miles Northwest of Fiddyment substation, north of Roseville's Wastewater Treatment Plant. The point of Interconnection is at the Western's 230 - kV Roseville Substation. Refer to Figure 1, attached. The results of the SIS will be utilized as a basis for a subsequent detailed facility interconnection study.

Western will utilize the Sacramento Area Transmission Planning Group (SATPG) as a coordination forum to solicit input from the area utilities and stakeholders for the study assumptions. Western will conduct the SIS studies and invite input from the interested stakeholders upon completion of the SIS study according to the study schedule.

II. Study Schedule

The following schedule contains both the initial System Impact Study (SIS) and the Detailed Facility Interconnection Study (DFIS) effort.

Milestone	Date
Finalize the Study Plan	May 15, 2001
Preliminary power flow results out for review	June 12, 2001
Finalize Transmission Configuration	June 20, 2001
Preliminary short circuit results	June 30, 2001
Preliminary stability results out for review	July 12, 2001
Comments on all preliminary results due back	July 20, 2001
Finalize the study results & Issue System Impact Study Report	July30, 2001
SATPG Meeting to discuss DFIS	TBD*
Comments on DFIS Study Plan - Final System Configuration	TBD*
Preliminary power flow results out for review	TBD*
Preliminary stability results out for review	TBD*
Draft DFIS Report	TBD*
Final DFIS Report	TBD*
*: To be determined based on the findings from the SIS.	

III. Base Case and Interconnection Configuration

PG&E's Annual Transmission Assessment 2005 Heavy Summer Full-Loop

Power Flow Base Case will be used for the studies. This case represents a summer peak load in northern California. Additional Base Case assumptions are summarized in the table below, which will be finalized based on the comments received

2005 SUMMER PEAK NORTH-TO-SOUTH CASE SUMMARY	
Study Path	**Flow (MW)**
PACI + COTP	4500 (Sensitivity studies will be performed at 4800 as well as lower COI levels.)
PDCI	2652 @ Sylmar
Midway – Vincent	Maximum up to 3000 MW
Planning Area Load	**MW**
PG&E	~ 27,795
Sacramento Area (also included in PG&E)	3140 (SMUD), 320 (Roseville)
Generation	**MW**
Sutter, DEC, LMEC, MEC, SECAL, Moss Landing, FPLE (Elverta), La Paloma, Sunrise, EAEC	Sutter: 525 LMEC: 500 DEC: 880 Three Mountain PP: 530 MEC: 600 MLPP: 1,080 CC SECAL: 590 FPLE (Elverta): 560 La Paloma: 1,110 Sunrise: 330 EAEC:107 0 As these units are added, power balance shall be maintained by first proportionally reducing the generation in SCE and SDG&E and then by reducing imports from the north
Morro Bay # 4	Reference (Swing Bus)
Northern California Hydro	3623.5 MW (90.3 %)
QF	Historical diversity level by unit

The Base Case will include the following assumptions:

- Load conditions in the area as described in the base case
- Round Mountain - Table Mountain Series Capacitor Upgrade
- Additional 500/230-kV Transformer at Tracy, Tesla and Metcalf
- A new Tesla-Newark 230 - kV line
- Static Capacitors (350 MVAR) at Metcalf 500 kV

- Static Capacitors (100 MVAR) at Martin 115 kV
- Newark-San Mateo 230-kV line looping into Ravenswood Substation
- Newark Substation Bank #7, 9 and 11 TCAP
- Los Banos-Gates 500kV Transmission Line
- Transmission and sub-transmission reinforcements committed by management (all area utilities) to be in-service on or before 2004

Sensitivity Cases

- 2005 Spring, Integrated CAISO Assessment case
- New power plant at Rancho Seco
- Interconnection between Western's Roseville Substation and PG&E's Atlantic Substation
- Interconnection of Folsom substation along Lake-Orangevale 230-kV line

2005 SPRING NORTH-TO-SOUTH CASE SUMMARY	
Study Path	**Flow (MW)**
PACI + COTP	4000 (Sensitivity studies will be performed at 4800 as well as lower COI levels.)
PDCI	3100 @ Sylmar
Midway – Vincent	3000 MW
Planning Area Load	**MW**
PG&E	~ 17,067
– Sacramento Area (also included in PG&E)	1551 (SMUD), 155 (Roseville)
Generation	**MW**
Sutter, DEC, LMEC, MEC, SECAL, Moss Landing, FPLE (Elverta), La Paloma, Sunrise, EAEC	Sutter: 408, LMEC: 0, DEC: 730 MEC: 0, MLPP: 0, CC SECAL: 472 FPLE (Elverta): 0, La Paloma: 0 Sunrise: 140, EAEC:0 As these units are added, power balance shall be maintained by first proportionally reducing the generation in SCE and SDG&E and then by reducing imports from the north
Morro Bay # 4	Reference (Swing Bus)
Northern California Hydro	1671.2 MW (41.7 %)
QF	Historical diversity level by unit

The initial REF interconnection configuration will be based on REF's proposal as shown in Figure 1. This configuration may be revised or changed during the course of the study based on performance merit and the overall system impact. The study team may make recommendations for additional studies as needed.

IV. Methodology and Approach

B. Power Flow Analysis

Western will develop the base cases, complete the power flow analysis, determine the impacts on all utilities, and present the preliminary interconnection feasibility study results to the study group and stakeholders.

D. Transient Stability Analysis

Using the 2005 base case selected contingencies will be simulated to verify transient stability. This will determine whether the Project would adversely impact system stability following those contingencies. The study group will develop a list of contingencies. Western will conduct transient stability analysis within this list of contingencies.

E. System Protection & Short Circuit Analysis

Short circuit studies will be conducted to determine the fault duties for the immediate substation and adjacent substations. The results will be shown in tables indicating the available fault before and after interconnection of the Project. In addition, overstressed equipment resulted from interconnecting the Project will be identified. Western and City of Roseville will conduct the short circuit analysis jointly.

F. Contingencies to Model

The following contingencies will be simulated for the study:

ISO Category "B" Outages
All participants will prepare line outage list and provide to the study group for their respective areas.

ISO Category "C" Outages
All participants will prepare line outage list and provide to the study group for their respective areas.

500 kV Outages
The following 500 kV outages will be run using post-transient power flow analysis incorporating the appropriate remedial actions (RAS):

500-kV Single Line Outages	500-kV Double Line Outages
Malin – Round Mountain	Malin – Round Mountain
Captain Jack – Olinda	Round Mountain - Table Mountain
Round Mountain – Table Mountain	Table Mountain-Tesla/Vaca Dixon
Table Mountain-Tesla	Tesla – Los Banos & Tracy - Los Banos
Olinda – Tracy	Tracy – Tesla & Tesla - Los Banos
Table Mountain – Vaca Dixon	Tracy – Tesla & Tracy - Los Banos
Vaca Dixon – Tesla	
Tesla – Los Banos	
Tracy – Los Banos	

ATTACHMENT - *Figure 1: Conceptual Interconnection Design (provided by REF.)*